Overlayer Effects on $La_{0.7}Sr_{0.3}MnO_3$

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Introduction: Using x-ray absorption spectroscopy (XAS) and x-ray magnetic circular dichroism (XMCD) techniques, we have investigated the electronic structure and magnetic properties of $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) as a function of LNO cap layer thickness. The Mn $L_{2,3}$ XAS and XMCD data clearly show that the magnetic properties and electronic structure of the LSMO is adversely affected by the LNO overlayer caused by cation displacement/exchange that effectively reduces the concentration of La atoms in the LSMO near the LNO/LSMO interface.

Methods and Materials: The XAS and XMCD spectra were measured at the NRL-NSLS Magnetic Circular Dichroism Facility located at beamline U4B at the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory. The beamline supplies monochromatic, circularly polarized x-rays (in this case, a polarization of 75% was used) in the energy range 20-1350 eV. The monochromator was set at a resolution of 0.15 eV at the Mn $L_{2,3}$ edge. The LSMO and LNO films were prepared by pulsed laser deposition (PLD) using $SrTiO_3$ (STO) substrates. The thick LSMO films were grown in an oxygen ambient of 400 mTorr at an elevated substrate temperature of 800°C. The YBCO films were grown in 150 mTorr and at 800°C. The Au film was deposited by plasma sputtering with the substrate held at room temperature

Results: The two figures display the evolution of the XAS and XMCD spectra for the Mn $L_{2,3}$ edge as a function of LNO overlayer coverage (**Figure 1**) or Au overlayer coverage (**Figure 2**).

Conclusions: We have shown that the effect of depositing LNO as a cap layer on LSMO is to modify the electronic and magnetic properties of the LSMO by effectively changing the Mn ground state configuration from ferromagnetic to antiferromagnetic as the cap layer thickness is increased. The mechanism is most likely a cation interchange where Ba from YBCO replaces La at the interface, thus modifying the relative concentration of Sr to La. Similarly, capping with Au is shown to be an effective method to protect the chemical character of the surface. Thus XAS and XMCD provide a valuable route to studying the magnetism at buried interfaces, which could be of significant value in optimizing the heterostructure for desirable properties.

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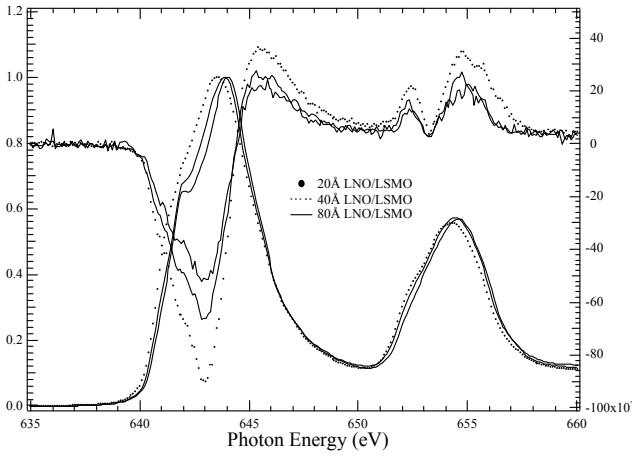

Figure 1. The XAS and XMCD spectra near the Mn L-edge energies for various coverages of LNO on LSMO.

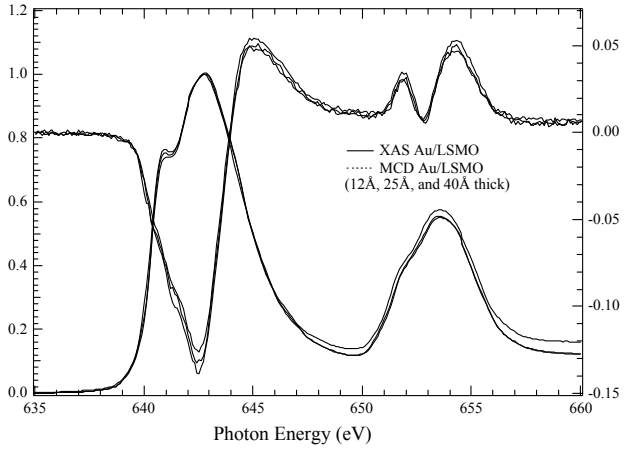

Figure 2. The XAS and XMCD spectra near the Mn L-edge energies for various coverages of Au on LSMO.